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INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Monitoring Program for Mercury in Precipitation in Indiana: Data Summary for 2001–2004

Precipitation Sample for Mercury Analysis

Fort Harrison

Clifty Falls

Roush Lake

Bloomington

Indiana Dunes

U.S. Geological Survey / Indiana Department of Environmental Management
Monitoring Program for Mercury in Precipitation in Indiana
Data Summary for January 2001 through December 2004

by Martin Risch, July 2005

Monitoring Program Data

The Indiana mercury-monitoring program is part of the National Atmospheric Deposition Network (NADP) Mercury Deposition Network (MDN) in North America. In the MDN, weekly precipitation samples are collected and analyzed for mercury. The weekly data are finalized and posted on the NADP-MDN website at *http://nadp.sws.uiuc.edu/mdn/*. The data for Indiana presented in this summary are based on the MDN weekly data and may include preliminary data that are not posted yet on the NADP-MDN website. A description of the monitoring program for mercury in precipitation in Indiana is available from the U.S. Geological Survey at *http://in.water.usgs.gov/newreports/mercury*.

Monitoring Stations in the Data Summary

Five monitoring stations for mercury in precipitation are operated in Indiana. They are listed by name, NADP-MDN identification number, and location:

- Roush Lake (IN20) near Huntington in Huntington County, northeastern Indiana;
- Clifty Falls (IN21) near Madison in Jefferson County, southeastern Indiana;
- Fort Harrison (IN26) near Indianapolis in Marion County;
- Bloomington (IN28) near Bloomington in Monroe County in southwestern Indiana;
- Indiana Dunes (IN34) near Porter in Porter County in northwestern Indiana.

Four of the monitoring stations were operated January 2001 through December 2004—Roush Lake, Clifty Falls, Bloomington, and Indiana Dunes. The Fort Harrison station was operated April 2003 through December 2004. All five stations are planned to operate during 2005 and through at least 2006.

Formats of the Data Summary

This data summary includes illustrations and tables. (Terms used in the data summary are defined in the next section, Terms in the Data Summary.) Eight illustrations show the following:

- Annual mercury wet deposition, annual normalized mercury wet deposition, and annual volume-weighted mercury concentrations in precipitation—for each year of the program, at each station, on a map of Indiana (figs. 1 through 4);
- Annual mercury wet deposition at each station, by year, on bar graphs (fig. 5);
- Seasonal mercury wet deposition and seasonal precipitation at each station during 2001 through 2004, on bar graphs (fig. 6); and
- Distributions of mercury concentrations in weekly precipitation samples (fig. 7) and weekly mercury wet deposition (fig. 8) during 2001 through 2004, on boxplots, for each station.

Three tables summarize information about:

- Precipitation samples;
- Mercury concentrations; and
- Mercury wet deposition.

Terms in the Data Summary

This summary quantifies mercury concentrations, mercury wet deposition, and precipitation in Indiana from January 2001 through December 2004. Following are definitions of the terms with the units of measure and methods of determination or calculation.

Mercury concentrations and wet deposition in this summary are for total mercury. Total mercury includes inorganic mercury and organic methylmercury. (Methylmercury is the form of organic mercury reported as part of total mercury and is the form of mercury that accumulates in the food chain.)

Mercury concentration is the mercury mass per amount of precipitation. Concentration is determined by laboratory analysis of the weekly precipitation sample accumulated in the automated collector at the monitoring station. Concentration units are nanograms per liter (equivalent to one-thousandth microgram per liter and approximately one part per trillion).

Median mercury concentration is a descriptive statistic for a group of mercury concentrations. When concentrations are ranked from smallest to largest, the median separates the ranked concentrations into two parts—half of the concentrations are greater than the median and half of the concentrations are less than the median. Units are nanograms per liter.

Volume-weighted mercury concentration is a computed value of a group of mercury concentrations weighted by the ratios of the sample volumes of the weekly samples to the total sample volume for the group. The volume-weighted concentration is a better representation of mercury concentrations in a group of precipitation samples than a simple mean (known as an “average”). Large concentrations in small volume samples will bias a simple mean but not a volume-weighted concentration. Units are nanograms per liter.

Weekly mercury wet deposition is a mercury mass per unit area, deposited in precipitation, during the weekly sample interval. Weekly deposition is calculated by multiplying the weekly sample concentration by the weekly precipitation amount. Units are nanograms per square meter per week.

Seasonal mercury wet deposition is the sum of the weekly mercury wet deposition for a season. For the NADP-MDN, each season has 13 weeks—winter (January through March), spring (April through June), summer (July through September) and fall (October through December). Units are nanograms per square meter per season.

Annual mercury wet deposition is the sum of the weekly mercury wet deposition for a year (typically 52 weeks). Units are nanograms per square meter per year.

Annual normalized mercury wet deposition is the annual mercury wet deposition divided by the annual precipitation. Differences in annual wet deposition among monitoring stations that are caused by differences in annual precipitation are removed when comparisons are made with normalized wet deposition. Units are nanograms per square meter per year per inch of precipitation.

Estimated weekly mercury wet deposition provides a wet-deposition value when a sampler malfunction or other error causes a mercury concentration to not be reported. Mercury wet deposition is estimated with the valid weekly precipitation amount and the seasonal volume-weighted mercury concentration. Units are nanograms per square meter per week.

Weekly precipitation amount is the rain, snow, and mixed (liquid and frozen) precipitation recorded by the rain gage at the monitoring station. The units are in inches because inches are used most frequently in weather reports in the United States. (The NADP-MDN website lists weekly precipitation in millimeters; 1 inch is equal to 25.4 millimeters; 1millimeter is equal to 0.0393701 inch.)

Seasonal precipitation is the sum of the weekly precipitation amounts for a season, using the NADP-MDN 13-week seasons defined above.

Annual precipitation is the sum of the weekly precipitation amounts for a year (typically 52 weeks).

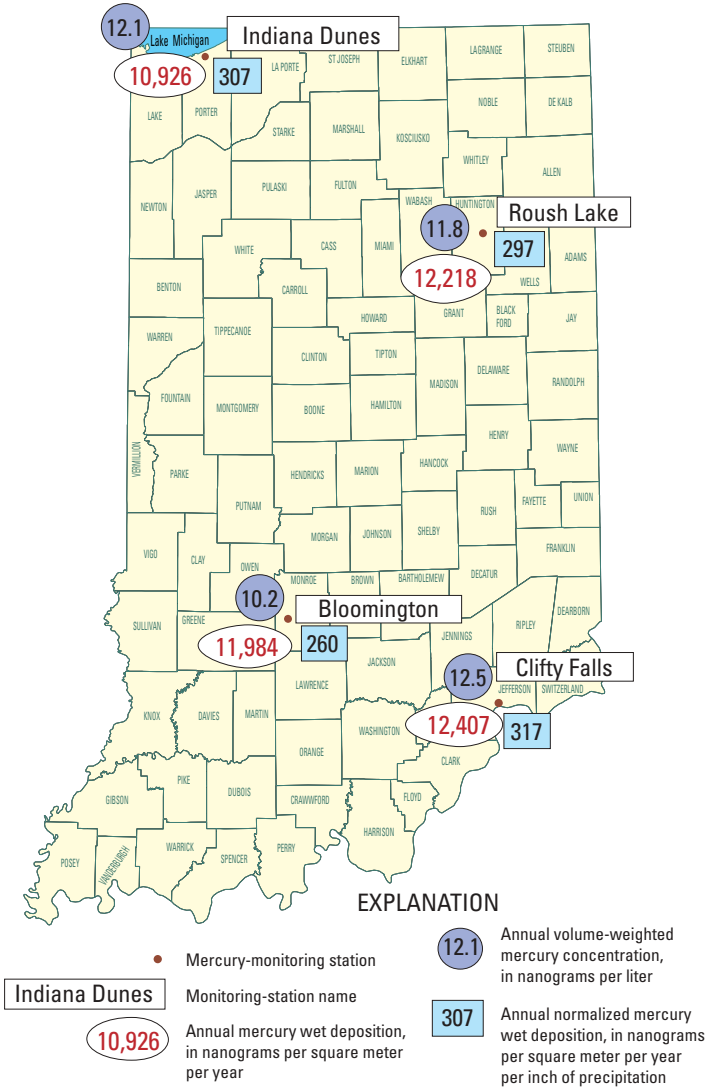

Figure 1. Annual mercury concentrations in precipitation and annual mercury wet deposition at four monitoring stations in Indiana during 2001.

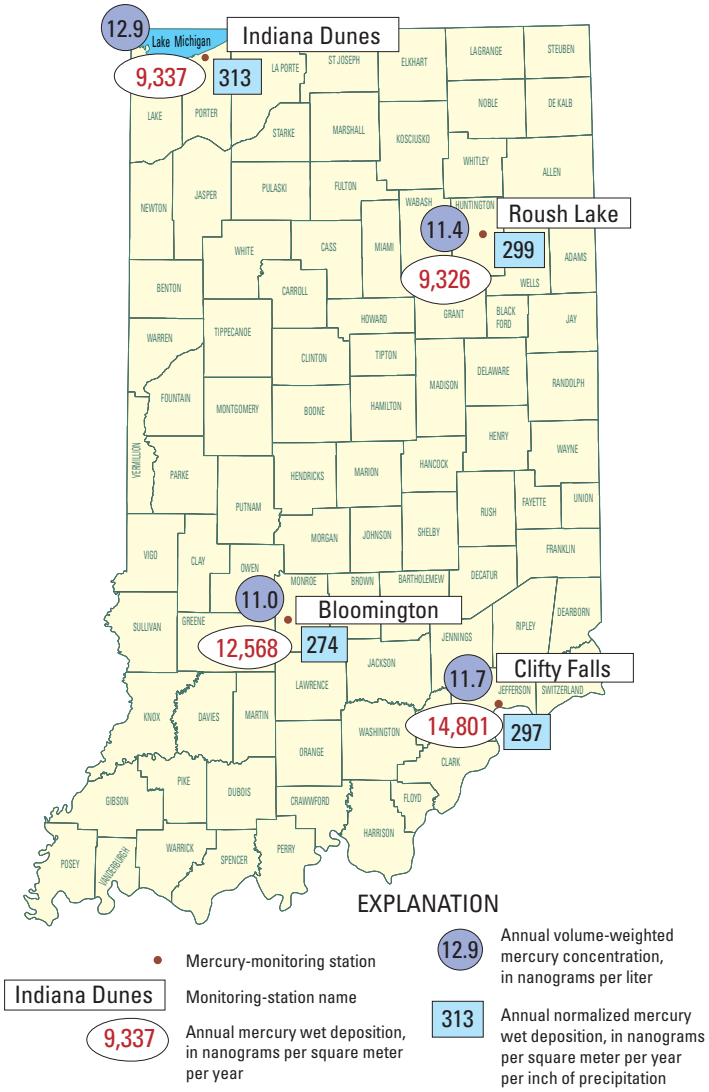

Figure 2. Annual mercury concentrations in precipitation and annual mercury wet deposition at four monitoring stations in Indiana during 2002.

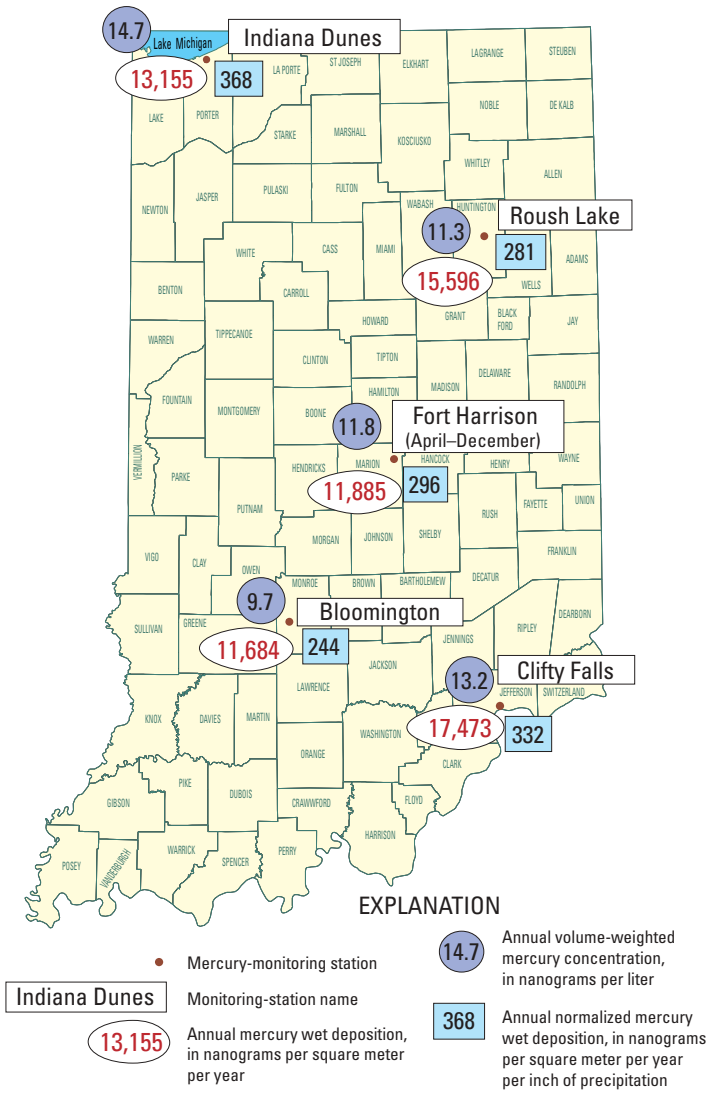

Figure 3. Annual mercury concentrations in precipitation and annual mercury wet deposition at five monitoring stations in Indiana during 2003.

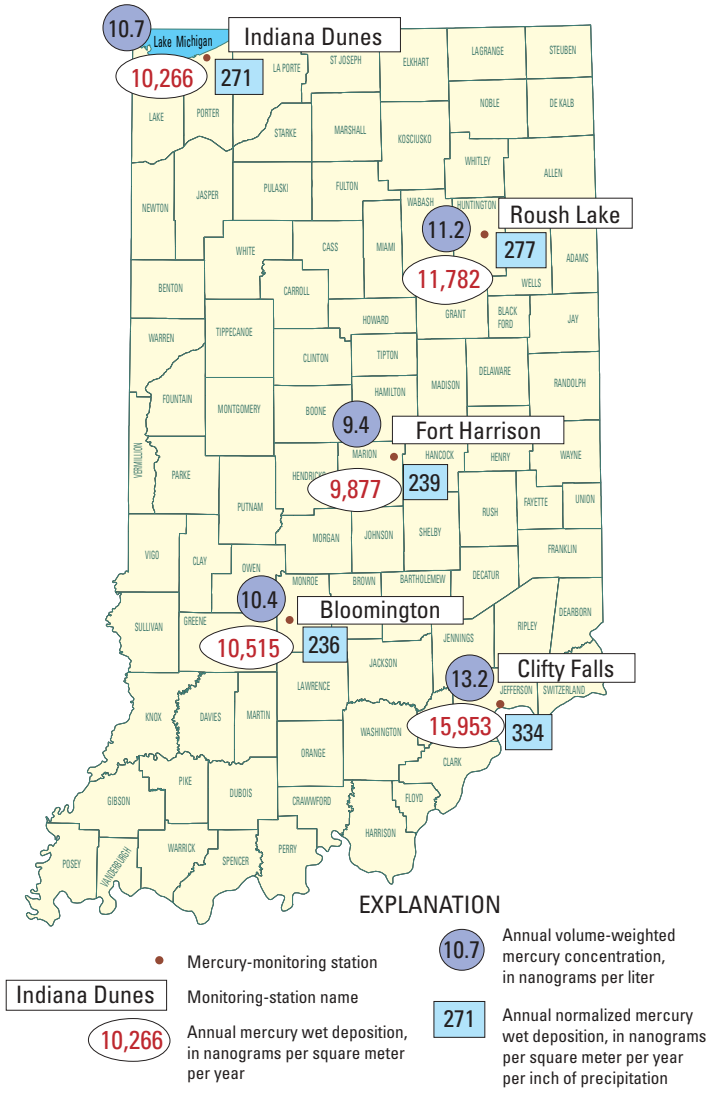

Figure 4. Annual mercury concentrations in precipitation and annual mercury wet deposition at five monitoring stations in Indiana during 2004.

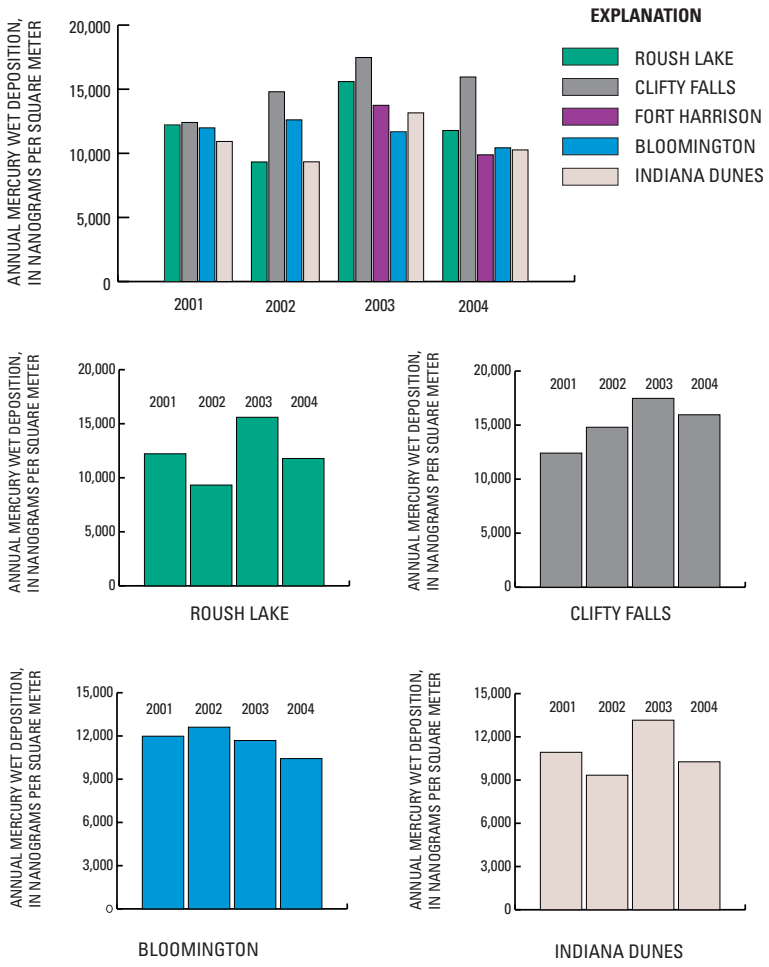

Figure 5. Annual mercury wet deposition at five monitoring stations in Indiana, January 2001 through December 2004.

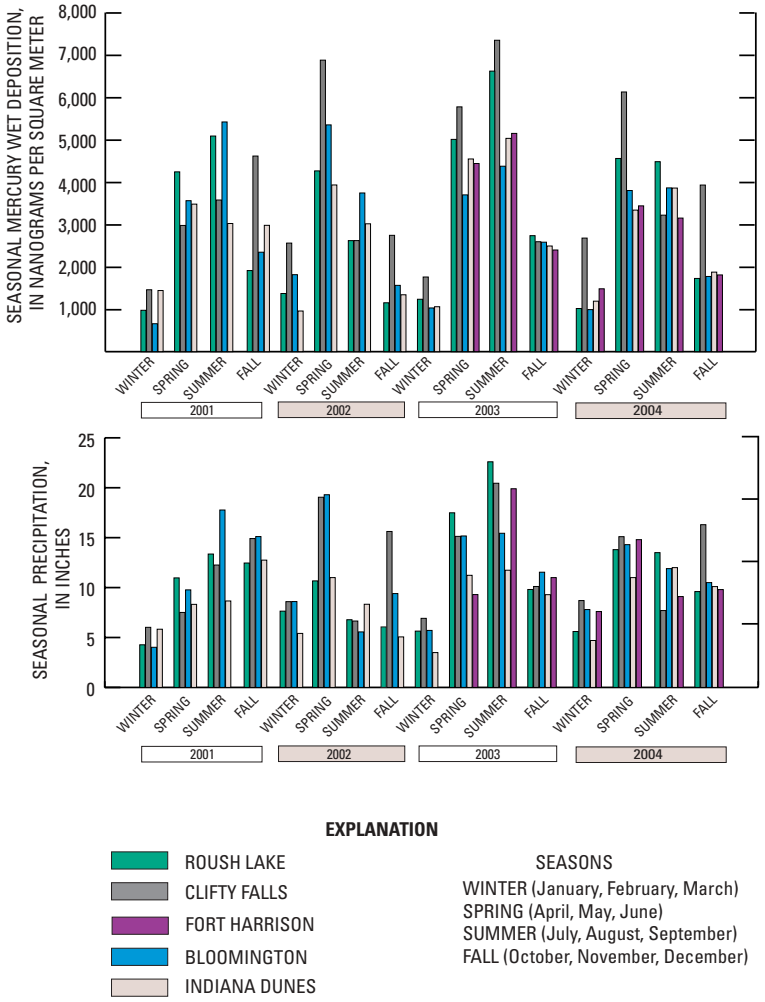

Figure 6. Seasonal mercury wet deposition and seasonal precipitation at five monitoring stations in Indiana, January 2001 through December 2004.

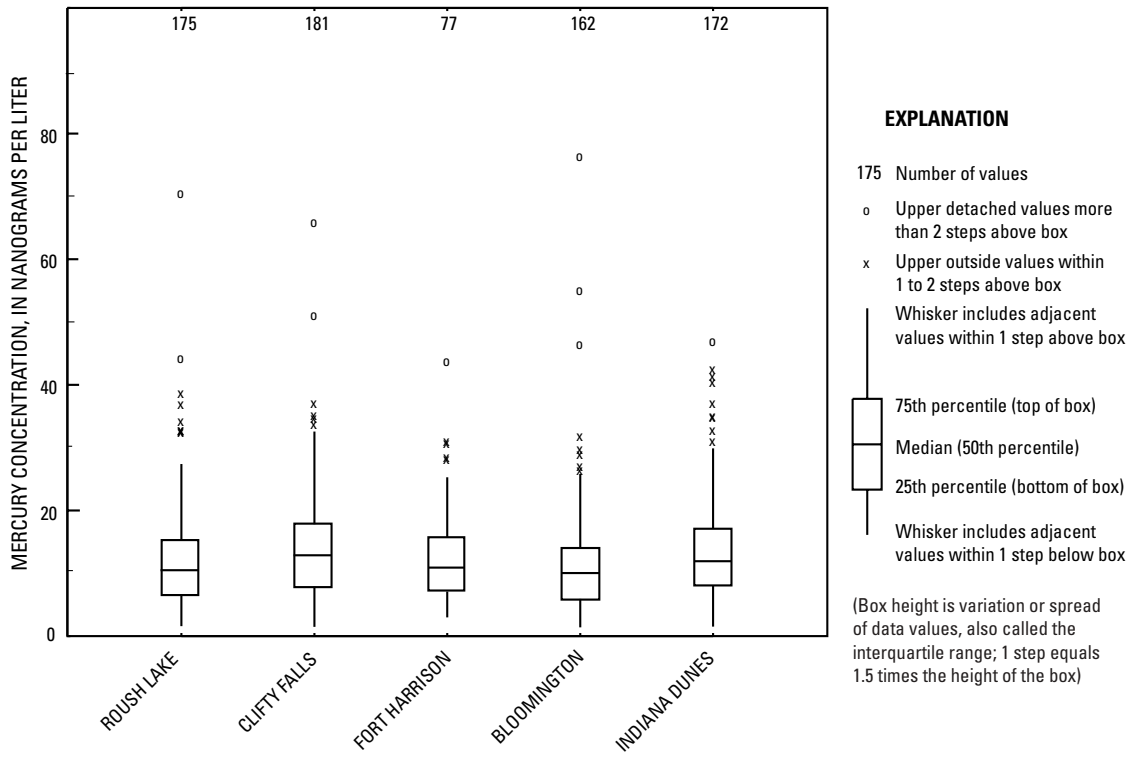

Figure 7. Standard boxplots showing the distribution of mercury concentrations in weekly precipitation samples from five monitoring stations in Indiana, January 2001 through December 2004.

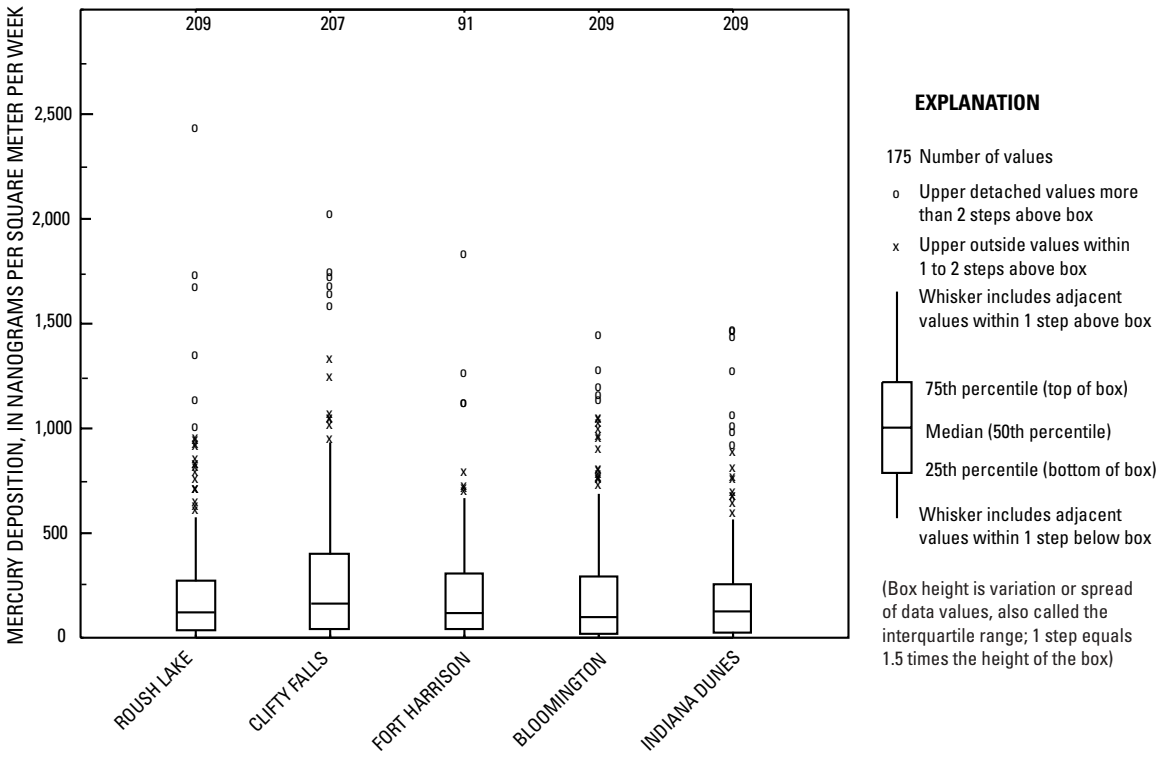

Figure 8. Standard boxplots showing the distribution of weekly mercury wet deposition from five monitoring stations in Indiana, January 2001 through December 2004.

Table 1. Precipitation samples for mercury monitoring at five stations in Indiana, January 2001 through December 2004.

[Data are for weekly precipitation samples; shaded rows contain totals for each station or for five stations; the sum of wet-deposition and dry samples equals the number of sample units installed; the sum of rain, snow, and mixed samples equals the number of wet-deposition samples]

Station name	Year	Number of sample units installed	Number of mercury wet-deposition samples[a]	Number of dry samples[b]	Number of rain samples	Number of snow samples	Number of mixed samples[c]
Roush Lake	2001	52	46	6	38	2	6
	2002	52	48	4	33	5	10
	2003	53	49	4	33	8	8
	2004	52	42	10	28	1	13
	4 years	**209**	**185**	**24**	**132**	**16**	**37**
Clifty Falls	2001[d]	50	44	6	39	0	5
	2002	52	45	7	39	3	3
	2003	53	51	2	41	4	6
	2004	52	44	8	36	2	6
	4 years	**207**	**184**	**23**	**155**	**9**	**20**
Fort Harrison	2003[e]	39	35	4	32	0	3
	2004	52	43	9	34	1	8
	2 years	**91**	**78**	**13**	**66**	**1**	**11**
Bloomington	2001	52	44	8	37	3	4
	2002	52	43	9	37	3	3
	2003	53	44	9	33	5	6
	2004	52	42	10	34	1	7
	4 years	**209**	**173**	**36**	**141**	**12**	**20**
Indiana Dunes	2001	52	46	6	38	1	7
	2002	52	43	9	31	6	6
	2003	53	48	5	32	13	3
	2004	52	47	5	35	4	8
	4 years	**209**	**184**	**25**	**136**	**24**	**24**
Five stations	**4 years**	**925**	**804**	**121**	**630**	**62**	**112**

[a]Includes 37 samples with estimated mercury deposition.
[b]Dry sample defined as less than 0.03 inch of precipitation; includes field blank sample.
[c]Mixed sample contains liquid and frozen precipitation.
[d]Does not include 2 weeks without precipitation or mercury-concentration data.
[e]Does not include 13 weeks prior to start of monitoring in April 2003.

Table 2. Mercury concentrations in precipitation samples at five monitoring stations in Indiana, January 2001 through December 2004.

[ng/L, nanogram per liter; data are for weekly precipitation samples; shaded rows contain concentrations or totals for each station or for five stations; 4-year median and volume-weighted concentrations cannot be computed with the annual values in this table]

Station name	Year	Median mercury concentration (ng/L)[a]	Volume-weighted mercury concentration (ng/L)[a]	Number of samples with mercury detected by laboratory[a]	Number of samples with mercury wet-deposition estimated	Number of mercury wet-deposition samples
Roush Lake	2001	11.4	11.8	44	2	46
	2002	10.1	11.4	42	6	48
	2003	11.0	11.3	47	2	49
	2004	8.9	11.2	42	0	42
	4 years	**10.5**	**11.2**	**175**	**10**	**185**
Clifty Falls	2001	11.2	12.5	43	1	44
	2002	13.4	11.7	44	1	45
	2003	12.6	13.2	51	0	51
	2004	14.5	13.2	43	1	44
	4 years	**12.9**	**12.6**	**181**	**3**	**184**
Fort Harrison	2003[b]	11.2	11.8	34	1	35
	2004	8.6	9.4	43	0	43
	2 years	**10.7**	**10.6**	**77**	**1**	**78**
Bloomington	2001	10.9	10.2	44	0	44
	2002	9.8	11.0	35	8	43
	2003	10.2	9.7	42	2	44
	2004	9.6	10.4	41	1	42
	4 years	**10.1**	**9.8**	**162**	**11**	**173**
Indiana Dunes	2001	12.7	12.1	43	3	46
	2002	11.3	12.9	38	5	43
	2003	14.1	14.7	44	4	48
	2004	10.1	10.7	47	0	47
	4 years	**12.0**	**12.2**	**172**	**12**	**184**
Five stations	**4 years**	**11.2**	**11.6**	**767**	**37**	**804**

[a]Does not include 37 samples with estimated mercury wet deposition. Median and volume-weighted mercury concentrations computed for samples with mercury detected by laboratory.

[b]Does not include 13 weeks prior to start of monitoring in April 2003.

Table 3. Mercury wet deposition at five monitoring stations in Indiana, January 2001 through December 2004.

[ng/m^2, nanogram per square meter; shaded rows contain totals for each station or for five stations; 4-year (or 2-year) values for normalized wet deposition, average weekly wet deposition, and average wet deposition per sample computed with 4-year (or 2-year) values and method in footnote—cannot be computed with 4 (or 2) annual values in this table]

Station name	Year	Annual precipitation (inch)	Annual mercury wet deposition[a] (ng/m^2)	Annual normalized mercury wet deposition[b] (ng/m^2/inch)	Average weekly mercury wet deposition[c] (ng/m^2)	Average mercury wet deposition per sample[d]
Roush Lake	2001	41.1	12,218	297	235	266
	2002	31.2	9,326	299	179	194
	2003	55.5	15,596	281	294	318
	2004	42.5	11,782	277	227	281
	4 years	**170.3**	**48,922**	**287**	**234**	**264**
Clifty Falls	2001	39.1	12,407	317	248	282
	2002	49.9	14,801	297	285	329
	2003	52.6	17,473	332	330	343
	2004	47.8	15,953	334	307	363
	4 years	**189.4**	**60,634**	**320**	**293**	**330**
Fort Harrison	2003	40.2	11,885	296	305	340
	2004	41.3	9,877	239	190	230
	2 years	**81.5**	**21,762**	**267**	**239**	**279**
Bloomington	2001	46.1	11,984	260	230	272
	2002	45.9	12,568	274	242	292
	2003	47.9	11,684	244	220	266
	2004	44.5	10,515	236	202	250
	4 years	**184.4**	**46,751**	**254**	**224**	**270**
Indiana Dunes	2001	35.6	10,926	307	210	238
	2002	29.8	9,337	313	180	217
	2003	35.7	13,155	368	248	274
	2004	37.9	10,266	271	197	218
	4 years	**139.0**	**43,684**	**314**	**209**	**237**
Average of 18 annual values for five stations	**4 years**	**42.5**	**12,320**	**291**	**241**	**276**

[a]Includes 37 samples with estimated mercury wet deposition.

[b]Computed as mercury wet deposition divided by precipitation amount.

[c]Computed as mercury wet deposition divided by number of sample units installed (table 1).

[d]Computed as mercury wet deposition divided by number of wet-deposition samples (table 1).